Claims

1. A method of producing a semiconductor integrated circuit device, comprising the steps of:

(a) forming a high dielectric constant insulating film over a semiconductor substrate;

(b) forming a conductive film on the high dielectric constant insulating film;

(c) forming an insulating film on the conductive film;

(d) selectively removing the insulating film thereby forming a pattern;

(e) etching the conductive film by using the insulating film having the pattern as a mask thereby forming a conductor piece;

(f) removing the insulating film to expose the upper surface of the conductor piece in a state of leaving the high dielectric constant insulating film on both ends of the conductor piece over the semiconductor substrate; and

(g) after the step (f), depositing a metal film on the conductor piece and forming a reaction layer at a portion of contact between the conductor piece and the metal film.

2. A method of producing a semiconductor integrated circuit device according to claim 1,

wherein the conductive film is a silicon film and the insulating film is a silicon oxide film.

3. A method of producing a semiconductor integrated circuit

device according to claim 1,

wherein the conductive film is a silicon film and the reaction layer is a silicide film.

4. A method of producing a semiconductor integrated circuit device according to claim 1,

wherein the high dielectric constant insulating film is a film having a specific dielectric constant of 2.0 or more.

5. A method of producing a semiconductor integrated circuit device according to claim 1, further comprising the step of:

(h) before the step (a), forming a trench in the semiconductor region by etching the semiconductor substrate and forming another insulating film in the trench,

wherein the high dielectric constant insulating film has a higher specific dielectric constant than that of another insulating film.

6. A method of producing a semiconductor integrated circuit device according to claim 1,

wherein the high dielectric constant insulating film comprises an alumina film, a titanium oxide film, a zirconium oxide film, a hafnium oxide film, a tantalum oxide film, or a ruthenium oxide film.

7. A method of producing a semiconductor integrated circuit device according to claim 1, further comprising the step of:

(h) between the step (f) and the step (g), removing the

high dielectric constant insulating film by using the conductor piece as a mask, which is a step of conducting etching under the condition where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece becomes large.

8. A method of producing a semiconductor integrated circuit device according to claim 1, further comprising the steps of:

(h) between the step (f) and the step (g), removing the high dielectric constant insulating film by using the conductor piece as a mask, which is a step of conducting etching under the condition where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece becomes large; and

(i) after the step (h), forming semiconductor regions on both sides of the conductor piece by implanting an impurity to the semiconductor substrate.

9. A method of producing a semiconductor integrated circuit device according to claim 1, further comprising the steps of:

(h) between the step (f) and the step (g), forming another insulating film over the semiconductor substrate including a portion on the conductor piece and then anisotropically etching another insulating film thereby forming sidewall films on the sidewalls of the conductor piece; and

(i) after the step (h), removing the high dielectric insulating film by using the conductor piece and the sidewall films as masks, which is a step of conducting etching under the

conditions where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece and the sidewall film becomes large.

10. A method of producing a semiconductor integrated circuit device, comprising the steps of:

(a) forming a first insulating film on a first region of a semiconductor substrate having the first region and a second region;

(b) forming a second insulating film having a higher dielectric constant than the first insulating film on the first insulating film and the second region;

(c) forming a conductive film on the second insulating film;

(d) forming a third insulating film on the conductive film;

(e) selectively removing the third insulating film thereby forming a pattern to each of the first and second regions;

(f) etching the conductive film by using the third insulating film having the pattern as a mask thereby forming a conductor piece to each of the first and second regions;

(g) removing the third insulating film in a state of leaving the second insulating film over the semiconductor substrate on both ends of the conductor piece thereby exposing the upper surface of the conductor piece; and

(h) after the step (g), depositing a metal film on the conductor piece and forming a reaction layer at a portion of

contact between the conductor piece and the metal film.

11. A method of producing a semiconductor integrated circuit device according to claim 10,

wherein the conductive film is a silicon film and the third insulating film is a silicon oxide film.

12. A method of producing a semiconductor integrated circuit device according to claim 10,

wherein the conductive film is a silicon film and the reaction layer is a silicide film.

13. A method of producing a semiconductor integrated circuit device according to claim 10,

wherein the first insulating film is a silicon oxide film and the second insulating film is a film having a specific dielectric constant of 2.0 or more.

14. A method of producing a semiconductor integrated circuit device according to claim 10,

wherein the second insulating film comprises an alumina film, a titanium oxide film, a zirconium oxide film, a hafnium oxide film, a tantalum oxide film, or a ruthenium oxide film.

15. A method of producing a semiconductor integrated circuit device according to claim 10, further comprising the step of:

(i) between the step (g) and the step (h), removing the high dielectric constant insulating film by using the conductor

piece as a mask, which is a step of conducting etching under the condition where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece becomes large.

16. A method of producing a semiconductor integrated circuit device according to claim 10, further comprising the steps of:

(i) between the step (g) and the step (h), removing the high dielectric constant insulating film by using the conductor piece as a mask, which is a step of conducting etching under the condition where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece becomes large;

(j) after the step (i), forming a first semiconductor regions on both sides of the conductor piece of the first region by implanting an impurity in the semiconductor substrate of the first region; and

(k) after the step (i), implanting an impurity in the semiconductor substrate of the second region thereby forming second semiconductor regions on both sides of the conductor piece of the second region.

17. A method of producing a semiconductor integrated circuit device according to claim 10, further comprising the steps of:

(i) between the step (g) and the step (h), forming another insulating film over the semiconductor substrate including a portion on the conductor piece and then anisotropically etching another insulating film thereby forming

sidewall films on the sidewalls of the conductor piece; and

(j) after the step (i), removing the high dielectric constant insulating film by using the conductor piece and the sidewall films as mask, which is a step of conducting etching under the condition where the etching selectivity of the high dielectric constant insulating film relative to the conductor piece and the sidewall film becomes large.

18. A semiconductor integrated circuit device having MISFET, the MISFET comprising:

(a) a conductor piece formed via a high dielectric constant insulating film over a semiconductor substrate; and

(b) a semiconductor region formed in the semiconductor substrate on both sides of the conductor piece,

wherein (c) the high dielectric constant insulating film extends as far as a portion below the end of the conductor piece.

19. A semiconductor integrated circuit device according to claim 18,

wherein the conductor piece is a silicon film and a silicide film is formed on the silicon film.

20. A semiconductor integrated circuit device having MISFET, the MISFET comprising:

(a) a conductor piece formed via a high dielectric constant insulating film over a semiconductor substrate;

(b) a semiconductor region formed in the semiconductor

substrate on both sides of the conductor piece; and

(c) a sidewall film formed on the sidewall of the conductor piece,

wherein (d) the high dielectric constant insulating film extends as far as a portion below the end of the sidewall film.

21. A semiconductor integrated circuit device according to claim 20,

wherein the conductor piece is a silicon film and a silicide film is formed on the silicon film.

22. A semiconductor integrated circuit device, comprising:

(a) a semiconductor substrate having a first region and a second region;

(b) a first MISFET including a pair of first semiconductor regions formed in the semiconductor substrate of the first region and a first conductor piece formed in a region between the pair of first semiconductor regions over the semiconductor substrate via a first insulating film and a second insulating film of a dielectric constant larger than the first insulating film; and

(c) a second MISFET including a pair of second semiconductor regions formed in the semiconductor substrate of the second region and a second conductor piece formed in a region between the pair of the second semiconductor regions and over the semiconductor substrate via the second insulating film,

wherein (d) the second insulating film extends as far as the portion below the end of the first and second conductor

pieces.

23. A semiconductor integrated circuit device according to claim 22,

wherein the conductor piece is a silicon film and a silicide film is formed on the silicon film.

24. A semiconductor integrated circuit device according to claim 23,

wherein a depth of the first semiconductor region is larger than a depth of the second semiconductor region.